# Lutetium 177 Production at the Maryland University Training Reactor

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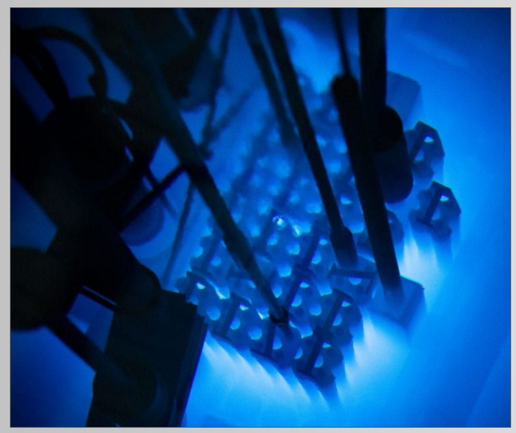
## Introduction

Lutetium 177 is a beta emitting radioisotope being developed as a radiopharmaceutical cancer treatment. Production of this isotope with a medium-power research reactor is being tested at the Maryland University Training Reactor (MUTR) for possible commercialization.

Initial testing was performed by generating small amounts of Lu-177 with the MUTR Rabbit system to evaluate production rates and reactivity worths of the samples.



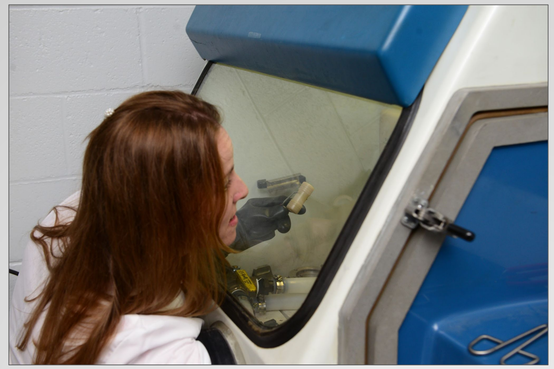
***Right:*** *The Maryland University Training Reactor core glowing with cherenkov radiation while operating.*

## Lutetium 177 Production

Lutetium 177 is produced by neutron activation. The isotope can be produced either by direct activation of Lutetium or an indirect method involving activation of Ytterbium.

In the “direct” method Lutetium 176 (2.6% of natural Lutetium) absorbs a neutron and becomes Lutetium 177.

In the “indirect” method, Ytterbium 176 (12.9% of natural Ytterbium) absorbs a neutron to become Ytterbium 177; the Yb-177 then decays with a 1.9 hour half life to Lu-177. The Lutetium can then be chemically separated from the Ytterbium. This method is usually preferred as it allows for the production of higher specific activity Lu-177.

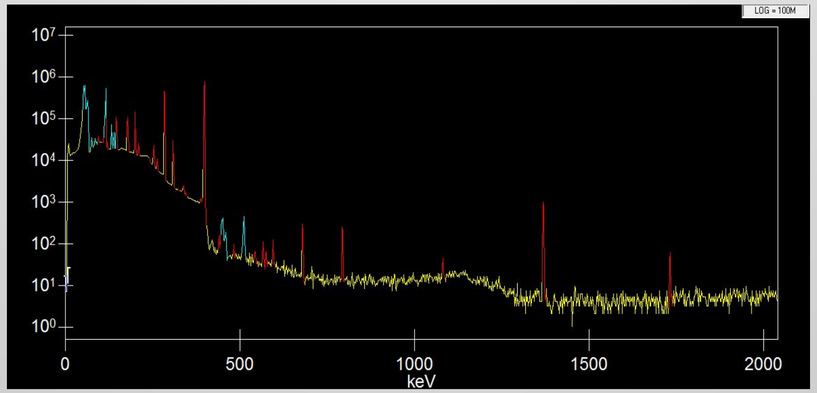


***Left:*** *A capsule of activated Ytterbium Oxide being handled in a glovebox at the MUTR.*

## Lu-177 Production Testing at the MUTR

Initial tests of indirect production of Lu-177 were performed at the MUTR by activating Ytterbium Oxide samples in the in-core pneumatic transfer system (Rabbit).

Samples ranging from 10 mg to 10 g were activated for times ranging from 1 to 20 minutes. The results of these activations were evaluated to determine the Lu-177 production rates and reactivity worths of Ytterbium Oxide. These results were used to validate simulations that will be used in designing future experiments.



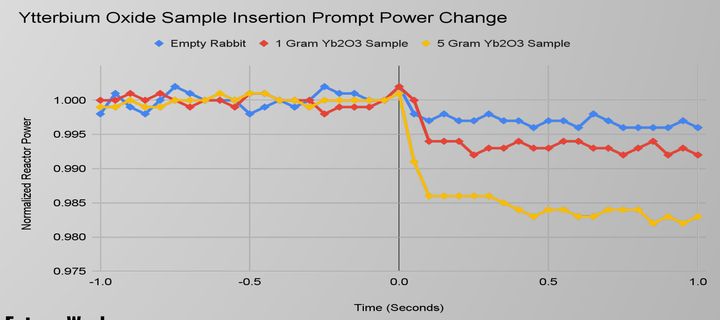

***Above:*** *A gamma spectrum of the activated Ytterbium Oxide sample showing Yb-169, Yb-175, and Lu-177.*

## Activity and Reactivity Measurements

Gamma spectroscopy was used to determine the amount of Lu-177 and other radioisotopes produced by the activation. This was used to verify the models used to estimate isotope production rates and to provide the necessary information to ship the samples to another facility for chemical separation of the Lutetium from the Ytterbium Oxide sample. The measured activities were found to be within 20% of the expected values.

The change in reactor power when the Ytterbium samples were inserted into the core was used to determine the reactivity worth of the samples in order to validate the models that would be used in order to determine if it is possible to safely scale up the experiment. The models were found to accurately predict the reactivity worth of samples in the rabbit.

***Above Left:*** *A High Purity Germanium gamma spectrometer at the University of Maryland Radiation Facilities.* ***Above Right:*** *An activated Ytterbium Oxide sample packaged for shipping.*
***Below:*** *A graph of reactor power as the Ytterbium oxide samples were inserted into the core. The power trace clearly shows the prompt drop in reactor power that was used to calculate the reactivity worth of the samples*




## Future Work

Following the successful initial production test in the MUTR rabbit, a scale-up experiment involving activating several kilograms of Ytterbium Oxide in the MUTR Through Tube is being planned to generate larger quantities of Lutetium 177.

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